ITS as a Data Source for Traditional Transportation Information Systems

Richard Margiotta

Cambridge Systematics

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CAMBRIDGE SYSTEMATICS

Study Purpose and Approach

- Examine potential of ITS to supply data to traditional transportation data systems
- Match "traditional" data elements to current ITS Sources
  - Identify "direct" and "near" matches for future harmonization
  - Timeliness and quality improvements
  - Opportunities for cooperation

ITS Sources Examined

- National ITS Architecture
  - Precursor to data dictionaries and is more general in nature
- Traffic Management Data Dictionary (ITE)
- P1512 Incident Management Data Dictionary (IEEE)
- Advanced Traveler Information System Data Dictionary (SAE)
- Data dictionaries include both data elements and message sets (combinations of data elements)
  - often share elements

Traditional Government Systems Examined

- Highway Performance Monitoring System (HPMS)
- Traffic Monitoring Guide (TMG)
- Highway Safety Information System (HSIS)
- National Bridge Inventory (NBI)
- National Transit Database (NTD)
- Fatality Analysis Reporting System (FARS)
- General Estimates System (GES)
- Motor Carrier Management Information System (MCMIS)
- National Governors' Association Truck Crash Data Elements
- Hazardous Material Incident Reporting System (HMIRS)
- Grade Crossing Inventory System (GCIS)
- Surveys (NPTS, VIUS, ATS)
- EPA Air Quality Models

Data Element Matching with DDs: Summary

Data System	No. Elements	Direct Matches	Near Matches
HPMS	98	20	9
TMG	45	4	11
HSIS	233	21	20
NBI	116	4	4
NTB	1,105	(crashes only); 48	
FARS	151	11	20

Data Element Matching with DDs : Summary (cont.)

Data System	No. Elements	Direct Matches	Near Matches
GES	79 (nonFars)	7	5
MCMIS Crash	51	9	10
NGA Truck	37	9	17
HMIRS	278	33	14
GCIS	134	5	4

Data Element Matching: HPMS

- Functional Classification
  - HPMS: 12 classes (Rural/ Urban, principal/major/minor, arterial/collector/llocal
  - TMDD: Freeway, Arterial, Collector, Local
- Route Signing and Number
  - HPMS: Valid values for route category; separate data items
  - TMDD: Free text for both route signing and number
- Governmental Ownership
  - HPMS: Valid values for each level of government
  - TMDD: Free text

Data Element Matching: HPMS (cont.)

- Type of Facility
  - HPMS: one-way/two-way, roadway/structure
  - TMDD: one-way operation defined, not roadway/structure
- Section Length
  - TMDD contains "link length", but matching TMDD links to HPMS sections is not addressed (geographic referencing a major impediment for ALL matching exercises)
- AADT
  - TMDD allows for "link volumes" but at unspecified time intervals

Data Element Matching: HPMS (cont.)

- Number of Through Lanes
  - TMDD and NIA both specify this data element exactly
- HOV Operation
  - TMDD identifies HOV ramps, but not lanes (?)
- ITS Technologies
  - TMDD can be used directly
- Surface/Pavement Type
  - HPMS: unpaved/low, med, hi flexible//high rigid/composite
  - TMDD: unpaved/concrete/asphalt/open graded asphalt

Data Element Matching: HPMS (cont.)

- Median Type
  - TMDD codes are more detailed; HPMS codes directly derivable
- Left/Right Shoulder Widths
  - Direct correspondence between TMDD and HPMS
- Weighted Design Speed
  - HPMS: derived from alignment information
  - TMDD: actual design speed of each link coded
- Speed Limit
  - Direct correspondence between TMDD and HPMS

Data Element Matching: HPMS (cont.)

- Intersection Turning Bays
  - Direct correspondence with TMDD, but HPMS definition of "typical" or "controlling" intersection must be determined
- Type of Signalization Control, Number of TCDs
  - Direct correspondence with TMDD
- Peak Capacity
  - Direct correspondence with TMDD

Data Element Matching: FARS

- Weather
  - TMDD: Codes do not correspond 1:1 with FARS
  - ATIS: current weather information is areawide, not crash-specific
- Work Zone Presence
  - TMDD: Work zones can be distinguished, but not all FARS codes can be obtained
- No. of Fatalities
  - TMDD and P1512 contain this data
- Collision Type
  - Direct correspondence with both TMDD and P1512

Data Element Matching: FARS (cont.)

- No. of Lanes, Relation to Junction, Surface Condition, Speed Limit
  - Direct correspondence with both TMDD and P1512
- Pavement Type
  - Most FARS codes derivable from TMDD
- Time of Crash
  - "Timeline Start" of incident in TMDD may be useful, but unclear as to whether it is related to crash time or detection time
- EMS Notification Time, Scene Arrival Time
  - P1512: Should be derivable from message sets

Data Element Matching: FARS (cont.)

- Traffic Control Devices
  - TMDD: Most FARS codes are derivable, but not all
- Number of Vehicle Axles
  - P1512: HazMat messages contain this data
- Body Type
  - P1512: FARS codes are directly derivable
- Vehicle Configuration
  - TMDD: FARS codes are more detailed
  - P1512: FARS codes are directly derivable

Data Element Matching: FARS (cont.)

- Hazardous Cargo
  - TMDD and P1512 both allow hazmat identification
  - ATIS has free text information in MayDay messages
- VIN
  - P1512 optionally provides VIN for hazmat trucks involved in incidents
  - ATIS identifies vehicles by their VIN
- Person-Level Injury Severity
  - TMDD and P1512: overall crash severity only

Observations and Challenges

- Existing Gov't Reporting: Coordination/definition of common data elements is good but not universal
  - Pavement Type; Highway Cross-Section; Access Control
- Location referencing for ITS and traditional databases are extremely inconsistent
  - Linear Referencing Systems vs. geospatial
  - TMDD networks vs. HPMS vs. TDF
- Several key data types offer potential for increasing amount, accuracy coverage, timeliness of submittals
  - Traffic, vehicle configuration, HazMat, carrier ID, injury severity

Observations and Challenges (cont.)

- ITS DDs definitions and valid values not always complete. Sometimes it's evident, sometimes not:
  - What's a "freeway"?
  - What's a "crash"? ("reportable" important for safety
  - Revisions are starting to account for these things
- Data Relationships are important considerations
  - Person-level injury severity
  - Traffic data: detector, lane, station, or roadway

Potential of Key ITS Data: Traffic

- National ITS Architecture ===➔ Regional Architectures ===➔
  DCM (field devices) ===➔ TMDD Messages ===➔
  Archived Traffic Data

- But most current deployments not currently following either standard

- Strengths:
  - Volume, Speed, Lane Occupancy, Density all considered
  - Freeway sensor density very high (~1/2 mile)
  - Essentially hundreds/thousands of ATRs deployed in an urban area
    - Short counts may be replaced with continuous counts
  - High temporal resolution – field reported @20-30 seconds

Potential of Key ITS Data: Traffic (cont.)

- Shortcomings:
  - No vehicle class, even though new equipment can detect it (video image processing) and it's required for density calculations from loops (real or virtual)
  - Currently only higher classes in urban areas
  - Quality unknown; down equipment often ignored
  - No metadata on equipment functioning, calibration, aggregation
  - Arterial data generally spotty; speed data not comparable to freeways
  - Detector/station locations not keyed to other referencing systems

ITS Traffic Data and MOBILE6 Emissions

- **Requires VMT and speed distributions by functional class and hour**
- **TDF Models most widely used tool for developing these, BUT:**
  - **Geared to peak hour**
  - **Volumes calibrated against short-term counts**
  - **Speeds not usually validated against anything**
    - BPR-like functions
    - no effects of incidents, work zones, weather, special events
    - Where validated, 1-3 floating car runs used
  - **Nonpeak hours backed out using data from 4-20 permanent count locations**
- **Still need ability to forecast, but ITS data can be used in validation**
- **Next generation AQ models even more detailed (modal profiles)**

Potential of Key ITS Data: Traffic (cont.)

Ideas for Improving ITS Traffic Data Integration

- Joint Control of ITS Detectors
  - Maintenance agreements with traditional Traffic Monitoring
  - Selection of key detectors – every ½ mile not needed
  - Sharing of quality control and calibration experience
- FHWA's INFOStructure
  - Opportunity for integration from the start
- Standards for Archiving ITS-Generated Data
  - Improve usefulness for *post hoc* applications

Summary

- Potential for ITS to provide a relatively small portion of data for traditional transportation information systems
  - "Enhance but not Replace" existing data collection
- Inconsistencies in definitions and valid values exist for common data elements
  - Traditional system owners more involved in standards update cycle
  - Short-term fix may be development of "cross-walks"

Summary

- **Key data elements can be the focus of reconciliation**
  - **Traffic, vehicle configuration, HazMat, carrier ID, injury severity**
  - **Idea of joint operation for field equipment**
    - Much accumulated wisdom by traditional data system personnel that can be useful to ITS
- **Much of the potential of ITS data for archived purposes lies beyond their ability to supply existing government reporting systems**
  - **New uses for ITS data will emerge that currently do not exist in traditional systems**

More Information

Rich Margiotta **ram@camsys.com**

Ralph Gillmann **ralph.gillmann@fhwa.dot.gov**